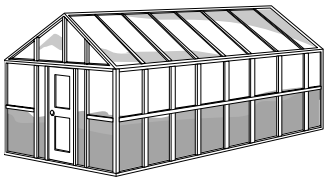
Best MANAGEMENT PRACTICES

Greenhouse Operations

2.1 Definition of Resource



The Department of Parks and Recreation (SPR) greenhouses produce more than 200,000 plants annually— including 145,000 annual and perennial flowering plants, seasonal color crops, rare and unusual herbaceous and woody plants., native plants and other desirable landscape plants. These facilities are used to propagate plants for introduction into park landscapes, and Volunteer Park Conservatory, Woodland Park Zoo, Seattle Center, Seattle City Light and Seattle Department of Transportation landscapes. These plants are grown as special collections, large production crops and individual specimens.

SPR grows its own annual and perennial flowering plants and through a contractual arrangement provides the same plants for other City departments. As with the propagation of woody landscape plants, it is most cost effective for SPR to grow these plants than it is to purchase them as finished plants. In-house propagation also provides significant flexibility in the range of plant species and a variety of plant sizes that can be grown.

The City of Seattle operates and maintains three greenhouses:

- **Jefferson Greenhouse:** This facility, located at 1600 S. Dakota Street, houses the production of annuals, perennials, natives, ornamentals and holiday crops for SPR as well as other City agencies.

- **Volunteer Park Greenhouse:** This facility supports a unique and valuable collection of exotics and tropical plants used in Volunteer Park Conservatory. Thousands of plants for seasonal color displays in the Volunteer Park Conservatory are also produced here.

- **Volunteer Park Conservatory:** A wide variety of exotics, tropical plants, and specialty crops for general viewing are displayed and maintained in this 7,000-square-foot facility. The conservatory is noted for its orchid collection.

2.2 Goal Statement

The goal of the greenhouse units is to provide superior customer service in delivering high quality, healthy plant material for use in public landscapes and in Volunteer Park Conservatory. Plants are propagated, grown on and available to Parks and other City departments through an in-house customized order system that allows a wide diversity of interesting plant material to be grown and promotes horticultural innovation and creativity among public landscape professionals. The greenhouses will provide plant material on time and in a healthy condition. The plants are propagated by seed and division and also purchased as rooted cuttings, plugs and bare root stock. The variety of material provided includes seasonal crops, spring and summer bulbs, annul and perennial flowers and evergreens, grasses, tropical and subtropical plants, trees, shrubs, vines and ground covers.

The Volunteer Park Conservatory is a living plant museum specializing in exotic plants from tropical and subtropical areas of the world. The plant collections exhibited are selected and arranged to display their aesthetic qualities and educational features. Our goals are to better serve the growing number of conservatory visitors, to continue expanding and refining the plant collection, and advancing education and interpretation programs by teaching the public about tropical and sub-tropical plants, habitat preservation and environmental awareness.

The mission of the Volunteer Park Conservatory is to cultivate, promote, and inspire the knowledge and appreciation of tropical and subtropical plants through exhibits, education and interpretation programs. The City of Seattle benefits from the Voluntary Park Conservatory as a historic landmark, a haven of beauty, and a center for conservation education.

2.3 Definitions

Clean Green: Refers to various plant debris such as leaves, pruned limbs, etc. that have not been contaminated with garbage and are suitable for recycling and composting.

Conservatory: A facility similar in construction to a greenhouse and used for the display of unique and exotic plants that typically cannot be grown outdoors in the Pacific Northwest.

Greenhouse: A house of glass construction used for the propagation, growing, and care of plants.

Nursery: A facility for the propagation and growing of plants for use on developed and undeveloped park property.

Poly-house or Shade-house: Terms for a greenhouse-type structure that provides a minimal level of protection from cold weather or from the sun required by nursery crops.

2.4 Policies and Guidelines

15.58 RCW - the Washington Pesticide Control Act and 17.21 RCW - the Washington Pesticide Application Act: Under this authority, the Compliance Branch of the Washington State

Department of Agriculture (WSDA) enforces federal and state regulations relating to the storage, distribution, transportation, disposal, and use of pesticides.

Landmark Historic Structures lists and guidelines: Volunteer Park Conservatory is a designated historic landmark. As such it is regulated for design changes, renovation, maintenance and other activities that may impact the integrity of the structure.
http://inweb/parks/referencedocs/

Landmark Preservation: Specific information about procedures related to historic structures such as Volunteer Parks conservatory.www.cityofseattle.net/neighborhoods/preservation

The Mayor's Environmental Action Agenda (EAA): The EAA presents the City's environmental goals and creates a framework for integrated City departmental environmental action. It addresses water conservation through mandates for increased energy and water efficiency of City buildings and facilities. The City has a continuing commitment to the Mayor's Environmental Action agenda

Pesticide Reduction Program: This program is an outgrowth of the Seattle Environmental Management Program (EMP) that was adopted to promote environmental stewardship in City operations. The two goals of the program are 1) to eliminate the use of the most potentially hazardous herbicides and insecticides and (2) to achieve a 30 percent reduction in overall pesticide use. The program outlines overall policies and rules governing purchasing, storage and use of pesticides, specific reduction goals and strategies to reduce use.

Sustainable Infrastructure Initiative (SII): The SII is a component of the Mayor's Environmental Action Agenda. It encourages application of innovative approaches that provide basic services in ways that are resource-efficient and environmentally responsible through a variety of incentive programs. Sustainable design encompasses the following broad topics:

- Efficient management of energy and water resources
- Management of material resources and waste
- Restoration and protection of environmental quality
- Enhancement and protection of health and indoor environmental quality
- Reinforcement of natural systems
- Analysis of the life cycle costs and benefits of materials and methods
- Integration of life cycle costs in design decision-making

Tri-County Pesticide Use Guidelines: The purpose of this document is to offer consistent and constructive advice to jurisdictions in King, Snohomish, and Pierce counties that have IPM programs. It offers clarifying information on specific IPM practices in various landscape types such as waterways, developed landscapes, and natural areas (See next page for online link).

http://www.govlink.org/hazwaste/interagency/ipm/ipmtricountyhome.html

2.4.1 Conservatory Policies and Guidelines

Plant Collections and Display Policy

- Set and develop high standards for plant displays within the Conservatory and establish high maintenance standards of Plant Collections.
- Rotate various plants in our large plant collections so all kinds of tropical and subtropical plants can be viewed and enjoyed.
- Present aesthetically and horticultural functionally landscape settings of permanent collection. Display seasonal shows frequently and diversely.
- Try to display annual/bulb plants in the front of the Conservatory with new designs and styles every year.
- Conserve and enhance our Endangered Species collection

Education & Interpretation Programs Development Program

- Initiate **botanical & environmental education programs**. Focus will be developing pesticide reduction and IPM education program for different ages and interests, endangered species interpretation and tropical rainforest education.
- Associating with the Friends of the Conservatory (FOC) and local communities to develop **outreach programs** for public education on exotic tropical and sub-tropical plants identification and conservation, rainforest habitat preservation, and environmental awareness.
- Work on plant collection slide and photo programs that can be presented by our gardeners or checked out by groups such as garden societies. It can generate interest and support.
- Maintain a master horticulture database in order to record all plant collections in Conservatory and use the information of botany, ecology, horticulture, conservation, ethnobotany as well as environmental biology and sociology for public or city employee education and interpretation.

2.5 Planning and Design

Volunteer Park Conservatory Architectural Perspectives

As a historical landmark in the City of Seattle, the preservation of the Volunteer Park Conservatory is very important. An architectural preservation policy and building management strategies will be created that will guarantee its preservation and landmark status for years to come. Of paramount importance is the establishment of routine annual inspection and maintenance, repair schedules, preservation program, sanitation system, and clarifying safety policies (See Policies and Guidelines, **Landmark Historic Structures lists and guidelines** and **Landmark Preservation**, page 9-3).

2.6 General Maintenance Practices

The section specific routine practices for greenhouse maintenance operation.

2.6.1 Building Maintenance

- Perform routine upkeep of all greenhouses, potting sheds, cold frames, lath houses, and storage sheds to provide for safe day-to-day operations.
- Keep all public areas clean and safe for workers and citizens visiting these areas.
- Clean and pressure wash all greenhouse floors and other work surfaces on a bi-monthly (or as-needed) basis.
- Maintain all equipment used in the greenhouses in good working order.
- Keep tools and supplies well organized and properly stored.
- Identify and direct annually scheduled preventive maintenance for the upkeep of the greenhouse and related structures and equipment.
- Winterize all systems before October 20th.

2.6.2 Production

Planning

- A calendar year plan shall be made for producing, distributing, or rotating plants, and for purchasing supplies.
- Accurate planning records shall be maintained and reviewed annually.

Propagation

- Methods of propagation shall include, but not be limited to, seeds and vegetative cuttings, divisions, plugs.
- Horticultural principles shall be specific to diverse crops whether exotic or native.
- Native and ornamental propagation is a cooperative effort between the Jefferson Greenhouse and the Atlantic City Nursery.

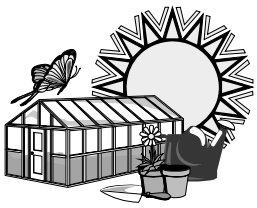
2.6.3 Cultural Care

The following are guidelines for preventing typical problems that can occur in greenhouses used as production facilities.

- Routinely groom and inspect crops. Remove algae from floors with pressure washer to prevent slipping. Clean benches and pots to reduce disease potential and as a safety factor for slips and falls.
- Adequately and thoroughly irrigate based on specific plant or crop cultural requirements. Fresh water flush without fertilizer is required once per week to reduce and leach out salt buildup in potting soils.
- Regular and consistent fertilizations programs are critical to cultural care of plants and crops. Fertilize crops as needed with a fertilizer appropriate to the plant or crop.
- Provide shade for those plants that need it.
- Bring plants indoors to protect them during winter. Close cold frames in freezing weather to protect crops. Use frost cover fabric on crops that are in the cold frames during below-freezing temperatures.
- Provide seasonal plant or drop cultural requirements for light, heat, and cold protection.

2.6.4 Climate Control Systems

- Jefferson and Volunteer Park Lower Support greenhouse facilities and Volunteer Park Conservatory utilize computers that control environmental conditions inside the houses.



- Ventilation, heating, misting systems, lighting, weather stations and sensors all contribute to maintain diverse conditions for optimal crop production and holding capabilities.

- All SPR greenhouses use GEMLINK Windows-based operating system software (Greenhouse Environmental Manager) designed by Q-Com of California.
- Greenhouses are all programmed separately depending on the conditions needed.
- Software upgrades are necessary to keep current with new technology.

2.6.5 Fertilizer Injector Systems

Jefferson and Volunteer Park Lower Support greenhouses are equipped with an injector system that fertilizes the plant crops through the irrigation system.

- Fertilize with the injector system every time watering is done unless the intent is to leach salt buildup. Use a low rate of 250 parts per million continuous liquid feed.
- A fresh water flush without fertilizer is required once per week to reduce and leach out salt buildup in potting soils.

2.7 Integrated Pest Management (IPM)

Greenhouses are a production operation dealing with large numbers of plants in a closed, non-public environment. Many of the crops grown or nurtured are exotic, unique, and/or extremely valuable. Because of these factors, the tolerance threshold for many pest problems is much less in the greenhouse or conservatory environment than it is in general park landscapes. While the greenhouse program received a King County Enviro-Star Award in 1998 for progressive IPM implementation, these facilities are nevertheless required to maintain and often use a broader palette of pesticide products.

The greenhouse complexes have traditionally used pesticides routinely to maintain plant collections and crops. This artificial closed environment is especially challenging for insect and disease management. With the advent of the Pesticide Reduction initiative, the collaborative strategy for pest management in greenhouses includes the following goals:

1. Plant species/cultivars will be chosen with few or no known pest problems in cultivation. Elimination of ‘pest magnet‘ species will be a priority. When this

strategy is not an option for specific aesthetic reasons or if a species is important to the overall collection, other options will be considered.
2. Continuing research into alternative strategies and "softer" products.
3. Consider pest resistance and manage accordingly. Utilize rotational strategies of chemical classes and strict tolerance thresholds.
4. Test and incorporate Insect Growth regulators into IPM.
5. Continue pest population monitoring
6. Identify Tier 2, 3,and 4 pesticides for use in reduction strategies.

2.7.1 Pest Tolerance Thresholds

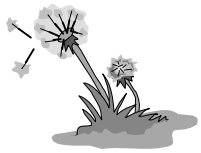
Because SPR greenhouses produce great numbers of plants in support of many SPR programs, pest tolerance thresholds are very low. The same is true for the Volunteer Park Conservatory, where much of the plant collection is very rare and of great value.

- Weeds are not tolerated in either City greenhouses or its Conservatory.
- Insect pests that threaten the health of plant collections or production crops are not tolerated in the greenhouses or conservatory.
- Disease pests that threaten the health of plant collections or production crops are not tolerated in the greenhouses or Conservatory.

2.7.2 Pest Management Control Strategies

Weed Control

The following are management techniques for weed control in greenhouses or the Conservatory.



- Greenhouse operating areas and containers and conservatory display spaces are kept free of weeds through hand/manual weeding.
- Weeds are controlled in exterior spaces, building perimeters, shade houses, cold frames and related areas either by hand or mechanically with push type mowers and string trimmers or suppressed with landscape fabrics.
- Utilize pesticide reduction strategies to minimize the presence of weed species. When pesticides are used, use the least toxic products and pay close attention to timing and seedling stages for control.

Insect Control

Insect pests are routinely monitored by visual inspection and use of sticky traps. Populations are kept below injury thresholds by:

- Proper cultural practices including regular irrigation, fertilization, soil management, light, and temperature management.

- Removal of insects by hand or washing them off the affected parts of the plants.
- Biological controls using beneficial insects and other organisms that attack pest insects. Periodic releases of beneficial insects help to suppress and reduce the need for chemical control.
- Spot treatments of the least toxic, yet effective, insecticide directed at specific plant parts for specific pest control.
- Discard infested plants if necessary.

Disease Control

Disease pathogens are controlled by the following methods:

- Provide good sanitation techniques including regular removal of plant debris and keeping tools and work areas clean.
- Provide proper spacing between plants for good air circulation.
- Select disease resistant plants.
- Keep diseased plants away from healthy crops.
- Apply the least toxic, but effective, pesticide product to control specific disease pathogen on a specific plant or crop.
- Discard infested plants if necessary.

2.8 Training

Basic Greenhouse Training

People who are inexperienced in greenhouse operations but who are expected to perform a wide range of skilled tasks for SPR must have a reasonable period of hands-on training. This includes new employees, seasonal employees, or volunteers. Experienced senior staff will provide the training. All new or seasonal employees and volunteers must have this training before they will be given full responsibility to work in SPR greenhouses or SPR nursery facilities. The training should be given in full-day increments, be as thorough as possible, and be specific to the location and type of work involved.

Basic comprehensive training on site operation, specific plant cultural care, and IPM should be developed as a training course and if possible, given during the less busy seasons of October through December or from June through July. Specific task training such as transplanting, potting, irrigation and other specific tasks as identified by greenhouse staff should be provided, as needed.

Training should include a yearly review of the Spill Response Plan and other Hazardous Materials plans as necessary.

Advanced Skills Training and Expert Consultation

Regular employees will be encouraged to pursue work related training to continue their professional skills development. This training can be internal to the Department or from a variety of horticultural venues, such as lectures, courses, seminars, and workshops offered at local courses at colleges and universities, the Center for Urban Horticulture, Washington State Department of Agriculture, government agencies, or horticultural organizations.

Networking with other professionals in the field of greenhouse and nursery management through field trips, site visits, and meetings will allow staff valuable information sharing on all aspects of management.

Experts in greenhouse IPM or other topics may provide onsite training and consultation for special problems or needs.

2.9 Appendices lists for Greenhouse Operations

ONLINE REFERENCES

1. **Landmark Historic Structures lists and guidelines:** Volunteer Park Conservatory is a designated historic landmark. As such it is regulated for design changes, renovation, maintenance and other activities that may impact the integrity of the structure. **http://inweb/parks/referencedocs/**

2. **Landmark Preservation**: Specific information about procedures related to historic structures such as Volunteer Parks conservatory. www.cityofseattle.net/neighborhoods/preservation

3. SPR Standards and Specifications: All mandated SPR construction standards that apply to landscape projects. http://www.cityofseattle.net/parks/projects/standards/specs.asp

4. **Tri-County Pesticide Use Guidelines:** The purpose of this document is to offer consistent and constructive advice to jurisdictions in King, Snohomish, and Pierce counties that have IPM programs. It offers clarifying information on specific IPM practices in various landscape types such as waterways, developed landscapes, and natural areas (See next page for online link).

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